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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/668,986	09/22/2003	Valery M. Dubin	10559/856001 / P17304/Int	1755
20985	7590	08/24/2004	EXAMINER	
FISH & RICHARDSON, PC 12390 EL CAMINO REAL SAN DIEGO, CA 92130-2081			IM, JUNGHWA M	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 08/24/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/668,986

Applicant(s)

DUBIN ET AL.

Examiner

Junghwa M. Im

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 August 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14, 32 and 33 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) _____ is/are rejected.
- 7) ☒ Claim(s) 1-14, 32 and 33 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 09/22/2003.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of claims 1-14 and 32-33 in the reply filed on August 4, 2004 is acknowledged.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2, 6, 9-10 and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 2 and 10 recite a limitation of "the diffusion barrier is an electroless diffusion barrier" and this does not carry a clear meaning.

Claim 6 recites a limitation of "the Sn alloy comprising one of 0.7Cu, Bi, Sb, and 3.5Ag" and this does not carry a clear meaning.

Claim 9 recites that the bump layer is comprised of Cu layer, while contacting with the diffusion barrier layer, and the solder layer. However, the instant invention, in particular, the figures of the instant invention fail to show this aspect.

Claim 13 recites "the base layer metal further contacts the diffusion barrier to physically *isolate all surfaces of the bump layer from the solder layer.*" However, the base claim 9 recites a limitation of "solder layer contacting the bump layer."

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by Wu et al. (US 6433427), hereinafter Wu.

Regarding claim 1, Fig. 1E of Wu shows an apparatus, comprising:

a semiconductor substrate (12);

a first conducting layer (14) in contact with the semiconductor substrate, the first conducting layer comprising a base layer metal, the base layer metal comprising Cu (col. 7, line 56);

a diffusion barrier (30; col. 2, line 5) in contact with the first conducting layer;

a wetting layer (28; col. 5, line 6) on top of the diffusion barrier; and

a bump layer (40) on top of the wetting layer, the bump layer comprising Sn (col. 1, line 24), the Sn bump a layer, the diffusion barrier being adapted to prevent Cu and Sn from diffusing through the diffusion barrier.

Note that "being electroplated" is a process designation, and would thus not carry patentable weight in this claim drawn to a product. See *In re Thorp*, 227 USPQ 964 (Fed. Cir. 1985).

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The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-2, 4-5 and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Mikagi et al. (US. Pat. Pub. 2003/0025202), hereinafter Mikagi.

Regarding claim 1, Fig. 4 of Mikagi shows an apparatus, comprising:

a semiconductor substrate (10);

a first conducting layer (12) in contact with the semiconductor substrate, the first conducting layer comprising a base layer metal, the base layer metal comprising Cu (paragraph 0049);

a diffusion barrier (16) in contact with the first conducting layer;

a wetting layer (17) on top of the diffusion barrier; and

a bump layer (20) on top of the wetting layer, the bump layer comprising Sn, the Sn bump layer, the diffusion barrier being adapted to prevent Cu and Sn from diffusing through the diffusion barrier (paragraph 0005).

Additionally, regarding a limitation of “being adapted to prevent...,” it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

Regarding claim 2, insofar as understood, Fig. 4 of Mikagi shows a diffusion barrier (16).

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Regarding claim 4, Fig. 4 of Mikagi shows a TiN/Ti adhesion layer (13A, 13B) and a Ni-V layer (16) on the base conductive layer (12). Note that the Ni-V layer (16) is made of four layers (shown in Fig. 5B), therefore one of the four layer can be used as a seed layer to form a Ni-V barrier layer. Note that the Ni-V layer on the base metal layer in the instant invention is also used as a seed layer for subsequent deposit of the barrier layer.

Regarding claim 5, Fig. 4 of Mikagi shows wherein the base layer metal further comprises a metal layer (12) positioned between the adhesion layer and the seed layer, wherein the metal layer comprises Al (paragraph 0049).

Regarding claim 8, Fig. 4 of Mikagi shows the apparatus further comprises a sputtered base layer metal (paragraph 0010), wherein the diffusion barrier is further adapted to reduce electromigration related to CuSn intermetallic formation (paragraph 0005).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mikagi in view of Imai et al. (US 6285083), hereinafter Imai.

Regarding claim 3, Mikagi shows the most aspect of the instant invention except “a solder layer positioned between the bump layer and a die package, wherein the solder layer comprises Sn.” Fig. 1 of Imai shows a solder layer (22) positioned between the bump layer (66)

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and a die package/mounting board (12), wherein the solder layer comprises Sn (col. 4, lines 45-48).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Imai into the device of Mikagi in order to have a Sn-alloyed solder layer positioned between the bump layer and a die package to make a complete package while using a Sn-alloyed solder layer for easier mounting.

Regarding claim 9, insofar as understood, Fig. 4 of Mikagi shows an apparatus, comprising:

a base layer metal (12) on a semiconductor substrate (10), the base layer metal comprising Cu (paragraph 0049);

a bump layer (20) on top of the base layer metal;

a diffusion barrier (16) in contact with the bump layer;

a wetting layer (17) on top of the diffusion barrier; and

the diffusion barrier being further adapted to prevent the diffusion of Cu and Sn through the diffusion barrier ((paragraph 0005).

Fig. 4 of Mikagi show the most aspect of the instant invention, except the bump layer comprised of Cu and “a solder layer contacting the bump layer, the solder layer comprising Sn.”

Fig. 1 of Imai discloses a bump (16) having a Cu (col. 3, line 17) and the solder layer (20, 22) comprising Sn (col. 3, line 38).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Imai into the device of Mikagi in order to have a bump

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comprised of Cu and the solder layer comprised of Sn to improve the reliability of the connection between the bump and the package.

The subject matter regarding claim 10 has been discussed above in claim 2.

The subject matter regarding claim 11 has been discussed above in claim 4.

The subject matter regarding claim 12 has been discussed above in claim 5. And regarding a limitation of “is adapted to suppress ...,” it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

Regarding claim 13, insofar as understood, Fig. 4 of Mikagi shows the diffusion barrier layer between the bump layer and the base metal layer.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mikagi in view of Tath (US 6614590).

Regarding claim 7, Mikagi shows the most aspect of the instant invention except “the wetting layer comprises one of CoB, NiB, and NIP, wherein the diffusion barrier is further adapted to reduce bump layer delamination.” Tath discloses a wetting layer material comprised of NiB (col. 7, lines 19-21).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Tath into the device of Mikagi in order to have a NiB wetting layer to improve wettability.

Regarding a limitation of “is further adapted to reduce ...,” it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mikagi in view of Kazama et al. (US 6639315), hereinafter Kazama.

Regarding claim 32, Fig. 4 of Mikagi shows an apparatus, comprising:

a semiconductor substrate (10);

a first conducting layer (12) in contact with the semiconductor substrate, the first conducting layer comprising a base layer metal, the base layer metal comprising Cu (paragraph 0049);

a diffusion barrier (16) in contact with the first conducting layer;

a wetting layer (17) on top of the diffusion barrier; and

a bump layer (20) on top of the wetting layer, the bump layer comprising Sn, the Sn bump layer, the diffusion barrier being adapted to prevent Cu and Sn from diffusing through the diffusion barrier (paragraph 0005).

Fig. 4 of Mikagi shows the most aspect of the instant invention except “one or more components comprising circuitry; and one and more layers on the circuit board to route at least one signal between components on the circuit board, wherein at least one of the components on the circuit board comprises a die packaging interconnect.” Fig. 5 of Kazama shows a circuit board (10) with a circuit for routing the signal.

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It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Kazama into the device of Mikagi in order to have a circuit board soldered to the interconnection of the semiconductor device to make a complete package.

Regarding claim 33, Kazama discloses a memory system on the circuit board (col. 15, line 18).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mikagi as applied to claim 1 above, and further in view of Lopatin et al. (US 6528409), hereinafter Lopatin and Kazama.

Regarding claim 6, insofar as understood, Mikagi fails to show “the diffusion barrier comprises one of CoBP, CoWP, COWB, CoWBP, NiBP, NiWP, NiWB, and NIWBP, wherein the bump layer further comprises a Sn alloy, the Sn alloy comprising one of 0.7Cu,Bi, Sb, and 3.5Ag, wherein the Sn bump layer being electroplated is further adapted to prevent low temperature phase transition of Sri from alpha Sn into beta Sn.” Lopatin discloses the diffusion barrier material is comprised of CoWP (col. 15, line 67).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Lopatin into the device of Mikagi in order to have the diffusion barrier comprised one of CoBP, CoWP, COWB, CoWBP, NiBP, NiWP, NiWB, and NIWBP since these materials are well-known in the art and readily available.

The combined teachings of Mikagi and Lopatin shows the most aspect of the instant invention except “the bump layer further comprises a Sn alloy, the Sn alloy comprising one of

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0.7Cu,Bi, Sb, and 3.5Ag, wherein the Sn bump layer being electroplated is further adapted to prevent low temperature phase transition of Sn from alpha Sn into beta Sn.” Kazama discloses a bump (9 in Fig. 1) is comprised of Sn-Ag-Cu-Bi (col. 12, lines 1-2).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Kazama into the device of Mikagi and Lopatin in order to have a solder bump comprised of Sn-Ag-Cu-Bi to improve soldering property.

Regarding a limitation of “being electroplated is further adapted to prevent ...,” it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mikagi and Imai as applied to claim 9 above, and further in view of Lopatin and Tatch.

Regarding claim 14, the combined teachings of Mikagi and Imai fail to show “the diffusion barrier comprises one of CoBP, CoWP, COWB, CoWBP, NiBP, NiWP, NiWB, and NIWBP, wherein the wetting layer comprises one of CoB, NiB, and NIP.”

Lopatin discloses the diffusion barrier material is comprised of CoWP (col. 15, line 67).

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Lopatin into the device of Mikagi and Imai in order to have the diffusion barrier comprised one of CoBP, CoWP, COWB, CoWBP, NiBP, NiWP, NiWB, and NIWBP since these materials are well-known in the art and readily available.

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The combined teachings of Mikagi, Imai and Lopatin shows the most aspect of the instant invention except "the wetting layer comprises one of CoB, NiB, and NIP." Tatoh discloses a wetting layer material comprised of NiB (col. 7, lines 19-21). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Tatoh into the device of Mikagi, Imai and Lopatin in order to have a NiB wetting layer to improve wettability.

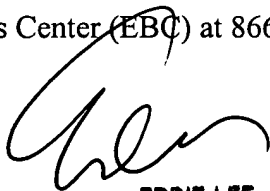
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (571) 272-1655. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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